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ABSTRACT

This curriculum guide for the metal trades was developed by the state of Mississippi to standardize vocational education course titles and core contents. The objectives contained in this document are common to all metal trades programs in the state. The guide contains objectives for Metal Trades I and II courses. Units in Metal Trades I cover the following topics: orientation; basic and related technology; hand and bench work; power saws and drilling machines; basic oxyacetylene welding, cutting, and brazing; basic shielded metal arc welding; basic machine shop; and basic sheet metal repair. Units in Metal Trades II cover advanced sheet metal, advanced welding, and advanced machine shop. Each unit consists of these components: objectives, with core/essential objectives indicated; suggested instructional practices; list of suggested resources; list of evaluation and suggested minimum performance standards, with core/essential objectives indicated; and performance record, with core/essential objectives indicated. A checklist for each course combining all unit performance standards into a single list is included. (KC)

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STANDARDIZED CURRICULUM

FOR

METAL TRADES

MISSISSIPPI DEPARTMENT OF EDUCATION

OFFICE OF VOCATIONAL, TECHNICAL

AND ADULT EDUCATION

June 1989

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FOREWORD

This volume is intended to be used in the State of Mississippi as a mechanism for standardizing vocational education course titles and core contents. The need for standardization of curricula was triggered by provisions in the Educational Reform Act of 1982 which mandated:

- -- elimination of nearly all currently existing curriculum requirements and development of new curriculum content that is "properly sequenced" and "coordinated";
- -- steps to ensure that students master one level of course work before being advanced to the next level and that progression is properly sequenced;
- -- a criterion-referenced, state-wide testing program that is built upon an identified set of "basic skills" keyed to student performance in grades 3, 5, 8, and 11;
- -- revised graduation requirements that take into account student performance on the basic skills and also on a test of "functional literacy skills"; and
- -- a system of accrediting schools that takes into account the performance of districts, schools, and students.

In addition to the mandates of the Educational Reform Act, the Strategic Plan for Vocational and Technical Education in Mississippi also calls for improving the quality of vocational and technical education through the standardization of curricula and the articulation of secondary and postsecondary programs.

Both of these mandates were further reinforced by legislation passed in 1986 which called for the establishment of state-wide "guidelines and procedures for managing an instructional program in the public schools." This legislation calls for instructional management plans containing the following components:

1. a written list of learning objectives for every course for which academic credit is given on students' transcripts (state specified core objectives must be included);
2. suggested instructional practices and resources for the learning objectives;
3. standards for student performance for each learning objective; and
4. systematic procedures for evaluating student performance on the learning objectives.

Specific local district actions regarding the state-wide instructional management plan are also required, namely:

1. The objectives contained in this document are common to all programs in the state. Core objectives are designated with an asterisk. The local district is encouraged to add additional objectives to this listing to meet local needs of students and employers.

2. The local school board must officially adopt the learning objectives as the district's curricula.

3. Pass/fail policies must be based on mastery of learning objectives.

4. Student performance on the learning objectives must be systematically evaluated at least once during the school year.

5. During the school year, records of individual student performance must indicate whether or not the objectives have been mastered. The record must indicate mastery status for each of the objectives tested in the Basic Skills Assessment Program (including functional literacy skills) and must be permanently maintained on all students who do <u>not</u> master the basic and functional literacy skills prior to being tested on them.

6. Each year, information about student performance on learning objectives must be reviewed. Those objectives which students are not mastering must be identified, and a plan must be developed for improving student performance on those objectives.

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METAL TRADES I

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METAL TRADES I

Unit 1: Orientation

Unit 2: Basic and Related Technology

Unit 3: Hand and Bench Work

Unit 4: Power Saws and Drilling Machines

Unit 5: Basic Oxyacetylene Welding, Cutting, and Brazing

Unit 6: Basic Shielded Metal Arc Welding

Unit 7: Basic Machine Shop

Unit 8: Basic Sheet Metal Repair

COURSE: Metal Trades I

Unit 1: Orientation

Objectives: Upon completion of this unit, the student will:

1. Define job titles associated with machine trades.
2. Describe personal traits and responsibilities necessary for machine trades workers.
*3. Identify the uses of the safety colors.
*4. Describe factors which contribute to personal safety.
*5. Describe factors which contribute to general shop safety.
*6. Describe factors which contribute to the maintenance of clean and orderly shop areas.
*7. Evaluate shop situations involving hazards.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop I. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981

Evaluation and Suggested Minimum Performance Standards:

Objective 1: The student will define seven job titles associated with machine trades.
Objective 2: The student will describe eight personal traits and responsibilities necessary for machine trades workers.
*Objective 3: The student will identify uses of six safety colors.
*Objective 4: The student will describe four factors which contribute to personal safety.
*Objective 5: The student will describe ten factors which contribute to general shop safety.
*Objective 6: The student will describe four factors which contribute to the maintenance of clean and orderly shop areas.
*Objective 7: The student will evaluate three shop situations involving hazards by listing three possible hazards in each situation.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

___ 1. Defined job titles associated with machine trades.
___ 2. Described personal traits and responsibilities necessary for machine trades workers.
___ *3. Identified the uses of the safety colors.
___ *4. Described factors which contribute to personal safety.
___ *5. Described factors which contribute to general shop safety.
___ *6. Described factors which contribute to the maintenance of clean and orderly shop areas.
___ *7. Evaluated shop situations involving hazards.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 2: Basic and Related Technology

Objectives: Upon completion of this unit, the student will:

*1. Calculate problems using fractions.
*2. Calculate problems using decimals.
*3. Identify the meaning of common blueprint symbols.
4. Write the meanings of abbreviations commonly used on blueprints.
*5. Identify the alphabet of lines used on blueprints.
*6. Identify the types of views shown on blueprints.
*7. Define the terms dimension and tolerance.
*8. Identify industry methods for showing dimensions and tolerance.
*9. Interpret information found in the title block of a blueprint.
*10. Read an industrial blueprint.
*11. Use a steel rule.
*12. Use a combination set.
13. Identify the major parts of micrometers.
*14. Describe the proper use of each type of micrometer.
*15. Read a micrometer setting.
*16. Use an outside vernier micrometer.
*17. Use a depth micrometer.
18. Describe the use of the different types of dial indicators.
*19. Align a vise using a dial indicator.
*20. Align a 4-jaw chuck with a dial indicator.
21. Identify gaging and inspection tools.
22. Identify correct uses of gaging and inspection tools.
*23. Use gage blocks.
*24. Distinguish between ferrous, non-ferrous, and non-metallic materials.
25. Perform a file and spark test.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop I. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981.

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will complete assignment sheets with 70 percent accuracy involving the conversion, addition, subtraction, multiplication, and division of fractions.

*Objective 2: The student will complete assignment sheets with 70 percent accuracy involving the addition, subtraction, multiplication, and division of decimals.

*Objective 3: The student will identify the meaning of ten common blueprint symbols.

Objective 4: The student will write the meanings of 25 abbreviations commonly used on blueprints.

*Objective 5: The student will identify nine different types of lines used on blueprints.

*Objective 6: The student will identify three types of views shown on blueprints.

*Objective 7: The student will define the terms dimension and tolerance.

*Objective 8: The student will identify four industry methods for showing dimensions and three methods for showing tolerance.

*Objective 9: The student will interpret information found in the title block of a blueprint with 70 percent accuracy.

*Objective 10: The student will read an industrial blueprint with 70 percent accuracy.

*Objective 11: The student will use a steel rule to measure three parts dimensions to the nearest 1/32 of an inch.

*Objective 12: The student will use a combination set to lay out lines to the nearest 1/32 of an inch, and angles to the nearest degree; and to find the center of a round part.

Objective 13: The student will identify six major parts of an outside vernier micrometer, four major parts of an inside micrometer and four major parts of a depth micrometer.

*Objective 14: The student will describe one proper use of each type of micrometer.

*Objective 15: The student will read a micrometer setting to the nearest 0.001 inch.

*Objective 16: The student will use an outside vernier micrometer to measure the dimensions of given parts to the nearest 0.001 inch.

*Objective 17: The student will use a depth micrometer to measure the dimension of a given part to the nearest 0.001 inch.

Objective 18: The student will describe one use of each of the four different types of dial indicators.

*Objective 19: The student will align a vise using a dial indicator to the tolerances recommended by the manufacturer.

*Objective 20: The student will align a 4-jaw chuck with a dial indicator to the tolerances specified by the manufacturer.

Objective 21: The student will identify 11 gaging tools and 8 inspection tools.

Objective 22: The student will identify one correct use of each gaging and inspection tool identified in Objective 21.

*Objective 23: The student will use gage blocks to make up three distances to within 0.001 inch.

*Objective 24: The student will distinguish between ferrous, non-ferrous, and non-metallic materials by correctly labeling twelve samples of materials.

Objective 25: The student will perform a file and spark test on metal specimens.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Calculated problems using fractions.
____ *2. Calculated problems using decimals.
____ *3. Identified the meaning of common blueprint symbols.
____ 4. Wrote the meanings of abbreviations commonly used on blueprints.
____ *5. Identified the alphabet of lines used on blueprints.
____ *6. Identified the types of views shown on blueprints.
____ *7. Defined the terms dimension and tolerance.
____ *8. Identified industry methods for showing dimensions and tolerance.
____ *9. Interpreted information found in the title block of a blueprint.
____*10. Read an industrial blueprint.
____*11. Used a steel rule.
____*12. Used a combination set.
____ 13. Identified the major parts of a micrometer.
____*14. Selected the proper micrometer for a given application.
____*15. Read a micrometer setting.
____*16. Used an outside vernier micrometer.
____*17. Used a depth micrometer.
____ 18. Described the use of the different types of dial indicators.
____*19. Aligned a vise using a dial indicator.
____*20. Aligned a 4-jaw chuck with a dial indicator.
____ 21. Identified gaging and inspection tools.
____ 22. Identified correct uses of gaging and inspection tools.
____*23. Used gage blocks.
____*24. Distinguished between ferrous, non-ferrous, and non-metallic materials.
____ 25. Performed a file and spark test.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 3: Hand and Bench Work

Objectives: Upon completion of this unit, the student will:

*1. Identify common hand tools and state the use of each.
*2. State rules for the safe use and care of hand tools.
3. List reasons for tap failure.
*4. Determine the proper size tap drill.
*5. Perform layout with a combination square, and saw and file to layout.
*6. State safety rules that apply to the pedestal grinder.
7. Interpret the numbering system for grinding wheels.
8. Discuss factors to consider in the care and storage of grinding wheels.
*9. Inspect and maintain a pedestal grinder.
*10. Grind a high speed tool bit.
11. Grind a drill bit.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop I. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981.

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will identify 30 common hand tools (cutting and non-cutting) and state one use of each tool.
*Objective 2: The student will state two rules for the safe use of each of the following: machinist's vice, wrenches, pliers, files, screwdrivers, chisels, hacksaws, and hammers; and will state four rules for care of hand tools.
Objective 3: The student will list five reasons for tap failure.
*Objective 4: The student will determine the proper size tap drill by completing a student assignment sheet with 70% accuracy.
*Objective 5: The student will perform a layout with a combination square, and saw and file the layout to specifications..
*Objective 6: The student will state 12 safety rules that apply to the pedestal grinder.
Objective 7: The student will interpret the numbering system for grinding wheels by identifying the type of abrasive, grain or grit, grade, structure and bond of a wheel.

Objective 8: The student will discuss six factors to consider in the care and storage of grinding wheels.

*Objective 9: The student will inspect and maintain a pedestal grinder by checking an new wheel for cracks, replacing a wheel, and dressing a wheel.

*Objective 10: The student will grind a high speed tool bit to specifications.

Objective 11: The student will grind a drill bit to specifications.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Identified common hand tools and state the use of each.
____ *2. Stated rules for the safe use and care of hand tools.
____ 3. Listed reasons for tap failure.
____ *4. Determined the proper size tap drill.
____ *5. Performed layout with a combination square, and sawed and filed to layout.
____ *6. Stated safety rules that apply to the pedestal grinder.
____ 7. Interpreted the numbering system for grinding wheels.
____ 8. Discussed factors to consider in the care and storage of grinding wheels.
____ *9. Inspected and maintained a pedestal grinder.
____ *10. Ground a high speed tool bit.
____ 11. Ground a drill bit.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 4: Power Saws and Drilling Machines

Objectives: Upon completion of this unit, the student will:

1. Identify the types of power saws.
2. List methods for determining band saw speeds for different materials.
3. State factors that determine saw blade selection.
*4. List rules for safe use of band saws.
5. Describe factors to consider in the care and cleaning of power saws.
6. Cut and weld a band saw blade.
7. Coil and uncoil a band saw blade.
*8. Cut stock to layout with a horizontal band saw.
*9. Cut stock to layout with a vertical band saw.
10. Identify the major parts of a drill press.
11. Describe operations performed by a drill press.
*12. Identify cutting tools used for drill press operations.
*13. Identify workholding and setup devices and other accessories used in drill press operations.
*14. State rules for the safe use of a drill press.
15. List and describe factors to consider in the care and cleaning of a drill press.
*16. Drill and ream holes to layout.
*17. Countersink and counterbore holes.
*18. Tap holes using a drill press.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop I. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981.

Evaluation and Suggested Minimum Performance Standards:

Objective 1: The student will identify three types of power saws.
Objective 2: The student will list two methods for determining band saw speeds for different materials.
Objective 3: The student will state four factors that determine saw blade selection.
*Objective 4: The student will list 12 rules for safe use of band saws.

Objective 5: The student will describe five factors to consider in the care and cleaning of power saws.
Objective 6: The student will cut and weld a band saw blade to specifications.
Objective 7: The student will coil and uncoil a band saw blade following accepted industry practices.
*Objective 8: The student will cut stock to layout specifications with a horizontal band saw.
*Objective 9: The student will cut stock to layout specifications with a vertical band saw.
Objective 10: The student will identify 14 major parts of a drill press.
Objective 11: The student will describe seven operations performed by a drill press.
*Objective 12: The student will identify six cutting tools used for drill press operations.
*Objective 13: The student will identify eight workholding and setup devices and five other accessories used in drill press operations.
*Objective 14: The student will state 14 rules for the safe use of a drill press.
Objective 15: The student will list and describe four factors to consider in the care and cleaning of a drill press.
*Objective 16: The student will drill and ream holes to layout specifications.
*Objective 17: The student will countersink and counterbore holes to specifications.
*Objective 18: The student will tap holes using a drill press to specifications.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ 1. Identified the types of power saws.
____ 2. Listed methods for determining band saw speeds for different materials.
____ 3. Stated factors that determine saw blade selection.
____ *4. Listed rules for safe use of band saws.
____ 5. Described factors to consider in the care and cleaning of power saws.
____ 6. Cut and welded a band saw blade.
____ 7. Coiled and uncoiled a band saw blade.
____ *8. Cut stock to layout with a horizontal band saw.
____ *9. Cut stock to layout with a vertical band saw.
____ 10. Identified the major parts of a drill press.
____ 11. Described operations performed by a drill press.
____ *12. Identified cutting tools used for drill press operations.
____ *13. Identified workholding and setup devices and other accessories used in drill press operations.
____ *14. Stated rules for the safe use of a drill press.

____ 15. Listed and described factors to consider in the care and cleaning of a drill press.
____*16. Drilled and reamed holes to layout.
____*17. Countersunk and counterbored holes.
____*18. Tapped holes using a drill press.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 5: Basic Oxyacetylene Welding, Cutting, and Brazing

Objectives: Upon completion of this unit, the student will:

*1. Identify the basic equipment used in oxyacetylene welding.
*2. List safety rules for using oxyacetylene equipment.
*3. Identify the parts of a welding torch body and the function of each.
*4. State guidelines for flame adjustment.
*5. Define the terms "backfire" and "flashback" and state possible causes.
*6. Identify the basic welding positions.
*7. Identify the basic welding joints.
*8. State elements of good fusion welding.
*9. State rules of thumb for rod and torch angles.
*10. Identify the types of oxyacetylene flames.
*11. State guidelines for welding tip selection.
*12. List guidelines for filler rod selection, handling, and safety.
*13. Set up equipment for oxyacetylene welding.
*14. Lay beads on a flat plate with no filler rod.
*15. Weld an outside corner joint in the flat position.
*16. Identify the parts of an oxyacetylene cutting torch.
*17. Set up equipment for oxyacetylene cutting.
*18. Make 90 degree cuts on mild steel.
*19. Distinguish between fusion welding and brazing.
20. List advantages and limitations of braze welding.
*21. State the purposes of flux.
22. List factors in successful braze welding.
23. Describe the technique for braze welding steel and cast iron.
*24. Braze weld a square groove butt joint in the flat position.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Fortney, Clarence and Gregory, Mike. Oxyacetylene Welding and Cutting. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984.

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will identify seven pieces of basic equipment used in oxyacetylene welding.

*Objective 2: The student will list 12 safety rules for using oxyacetylene equipment related to the work area, clothing, and cylinders and gases.

*Objective 3: The student will identify the two parts of a welding torch body and state the function of each.

*Objective 4: The student will state four guidelines for flame adjustment.

*Objective 5: The student will define the terms "backfire" and "flashback" and state six possible causes.

*Objective 6: The student will identify the four basic welding positions.

*Objective 7: The student will identify the five basic welding joints.

*Objective 8: The student will state four elements of good fusion welding.

*Objective 9: The student will state four rules of thumb for rod and torch angles.

*Objective 10: The student will identify the characteristics of three types of oxyacetylene flames.

*Objective 11: The student will state four guidelines for welding tip selection.

*Objective 12: The student will list four guidelines for filler rod selection, handling, and storage.

*Objective 13: The student will set up equipment for oxyacetylene welding including attaching regulators and lines; and lighting, adjusting, and shutting off the torch following industry accepted procedures.

*Objective 14: The student will lay beads on a flat plate with no filler rod to industry standards.

*Objective 15: The student will weld an outside corner joint in the flat position to industry standards.

*Objective 16: The student will identify seven parts of an oxyacetylene cutting torch.

*Objective 17: The student will set up equipment for oxyacetylene cutting including lighting, adjusting, and shutting off the torch.

*Objective 18: The student will make 90-degree cuts on mild steel following industry practices.

*Objective 19: The student will state two differences in fusion welding and brazing.

Objective 20: The student will list five advantages and three limitations of braze welding.

*Objective 21: The student will state five purposes of flux.

Objective 22: The student will list three factors in successful braze welding.

Objective 23: The student will describe five steps in brazing steel or cast iron.

*Objective 24: The student will braze weld a square groove butt weld in the flat position to industry standards.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Identified the basic equipment used in oxyacetylene welding.
____ *2. Listed safety rules for using oxyacetylene equipment.
____ *3. Identified the parts of a welding torch body and the function of each.
____ *4. Stated guidelines for flame adjustment.
____ *5. Defined the terms "backfire" and "flashback" and stated possible causes.
____ *6. Identified the basic welding positions.
____ *7. Identified the basic welding joints.
____ *8. Stated elements of good fusion welding.
____ *9. Stated rules of thumb for rod and torch angles.
____*10. Identified the types of oxyacetylene flames.
____*11. Stated guidelines for welding tip selection.
____*12. Listed guidelines for filler rod selection, handling, and safety.
____*13. Set up equipment for oxyacetylene welding.
____*14. Laid beads on a flat plate with no filler rod.
____*15. Welded an outside corner joint in the flat position
____*16. Identified the parts of an oxyacetylene cutting torch.
____*17. Set up equipment for oxyacetylene cutting.
____*18. Made 90-degree cuts on mild steel.
____*19. Distinguished between fusion welding and brazing.
____ 20. Listed advantages and limitations of braze welding.
____*21. Stated the purposes of flux.
____ 22. Listed factors in successful braze welding.
____ 23. Described the technique for braze welding steel and cast iron.
____*24. Braze welded a square groove butt joint in the flat position.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 6: Basic Shielded Metal Arc Welding

Objectives: Upon completion of this unit, the student will:

1. Describe the relationship between the elements of shielded metal arc welding (SMAW).
*2. Describe how flux-covered electrodes work.
*3. State safety rules related to SMAW welding.
*4. List safety equipment required for SMAW welding.
5. Describe the basic electrical characteristics of welding machines.
6. Describe the performance characteristics of the different types of SMAW welding machines.
*7. Identify the meaning of the numbers in the AWS electrode code classification.
8. Describe the basic elements of arc welding.
*9. Identify electrode angles.
*10. Describe SMAW welding techniques.
11. Identify bead running techniques and state the applications of each.
*12. Describe the procedures for restarting an arc and for filling a crater.
*13. Describe the characteristics of good and bad welds.
*14. List factors which contribute to poor welds and state the cause and solution of each.
*15. Strike and restrike an arc, and crater and backfill a bead.
*16. Build a pad.
*17. Construct a V-groove butt joint in the flat position.
*18. Construct a V-groove butt joint in the horizontal position.
*19. Construct a multiple pass T-joint in the horizontal position.
*20. Construct a T-joint in the vertical up position.
*21. Construct a v-grove butt joint in the vertical down position.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Fortney, Clarence and Gregory, Mike. SMAW: Shielded Metal Arc Welding. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984.

Evaluation and Suggested Minimum Performance Standards:

Objective 1: The student will describe the relationship between the arc, base metal, electrode, and flux in the SMAW process.

*Objective 2: The student will describe two factors concerning how flux-covered electrodes work.

*Objective 3: The student will state 12 safety rules related to SMAW welding electrical safety, cable handling, and eye safety.

*Objective 4: The student will list six pieces of safety equipment and clothing required for SMAW welding.

Objective 5: The student will describe the basic electrical characteristics of welding machines, including the basic circuit, polarity, and AC and DC current.

Objective 6: The student will describe a performance characteristic of three different types of SMAW welding machines.

*Objective 7: The student will identify the meaning of four symbols and numbers in the AWS electrode code classification.

Objective 8: The student will describe six basic elements of arc welding.

*Objective 9: The student will identify three electrode angles as related to the base metal.

*Objective 10: The student will describe nine fundamental SMAW welding techniques.

Objective 11: The student will identify six bead running techniques and state an application of each.

*Objective 12: The student will describe the procedures for restarting an arc and for filling a crater.

*Objective 13: The student will describe the characteristics of good and bad welds in terms of current, voltage and speed.

*Objective 14: The student will list five factors which contribute to poor welds and state one cause and solution for each.

*Objective 15: The student will strike and restart an arc, and crater and backfill a bead while running a bead on mild steel plate.

*Objective 16: The student will build a pad on mild steel plate in the flat position to specifications.

*Objective 17: The student will construct a V-groove butt joint in the flat position to specifications.

*Objective 18: The student will construct a V-groove butt joint in the horizontal position to specifications.

*Objective 19: The student will construct a multiple pass T-joint in the horizontal position to specifications.

*Objective 20: The student will construct a T-joint in the vertical up position to specifications.

*Objective 21: The student will construct a v-grove butt joint in the vertical down position to specifications.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ 1. Described the relationship between the elements of shielded metal arc welding (SMAW).
____ *2. Described how flux-covered electrodes work.
____ *3. Stated safety rules related to SMAW welding.
____ *4. Listed safety equipment required for SMAW welding.
____ 5. Described the basic electrical characteristics of welding machines.
____ 6. Described the performance characteristics of the different types of SMAW welding machines.
____ *7. Identified the meaning of the numbers in the AWS electrode code classification.
____ 8. Described the basic elements of arc welding.
____ *9. Identified electrode angles.
____ *10. Described SMAW welding techniques.
____ *11. Identified bead running techniques and state the applications of each.
____ *12. Described the procedures for restarting an arc and for filling a crater.
____ *13. Described the characteristics of good and bad welds.
____ *14. Listed factors which contribute to poor welds and stated the cause and solution of each.
____ *15. Struck and restruck an arc, and cratered and backfilled a bead.
____ *16. Built a pad.
____ *17. Constructed a V-groove butt joint in the flat position.
____ *18. Constructed a V-groove butt joint in the horizontal position.
____ *19. Constructed a multiple pass T-joint in the horizontal position.
____ *20. Constructed a T-joint in the vertical up position.
____ *21. Constructed a V-groove butt joint in the vertical down position.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 7: Basic Machine Shop

Objectives: Upon completion of this unit, the student will:

1. Describe the use of the different types of lathes.
*2. Identify the parts and subparts of an engine lathe and state the use of each.
*3. Identify and state the use of common lathe accessories.
*4. State rules for the care and cleaning of engine lathe.
*5. State rules for the safe use of an engine lathe.
*6. Describe the basic operations performed on a lathe.
*7. Identify the different types of tool posts and toolholders and state the use of each.
*8. Identify basic shapes of single-point cutting tools.
9. State advantages and disadvantages of carbide and high speed steel cutting tools.
*10. Use shop formulas and charts to determine lathe speeds and feeds.
*11. Free-hand grind a turning tool.
*12. Free-hand grind a facing tool.
*13. Free-hand grind a 60-degree threading tool.
*14. Sharpen a cutoff tool blade.
*15. Operate lathe controls.
*16. Use taper formulas to calculate dimensions.
17. Identify parts of the American National thread form.
*18. Identify thread forms.
*19. List methods for measuring thread pitch diameters.
*20. Remove and install a lathe chuck.
*21. Perform a facing operation.
*22. Face a part to length.
*23. Perform a straight turning operation.
*24. Turn a part with square shoulder to length.
*25. Perform a center-drilling operation.
26. Identify the parts of a grinding wheel.
27. State a use for each of the common grinding wheel types.
28. Describe factors used in determining the composition of a grinding wheel.
29. Identify the different types of abrasive cutting machines.
*30. State reasons for truing and balancing grinding wheels.
31. Identify the parts of a surface grinder and state the function of each part.
32. List and describe grinding operations problems and their causes.
*33. State rules for grinding machine safety.
*34. Operate surface grinder controls.
*35. Balance a grinding wheel.
*36. Identify surface grinding operations.
*37. State safety rules that apply to magnetic chuck work.
38. Name the types of milling machines.
39. Identify the parts of a horizontal knee-and-column mill and state the use of each part.

*40. Identify work holding devices, cutting tools, tool holders, and other attachments used with milling machines.
*41. State rules applying to milling machine safety.
*42. Adjust machine speed and feed rates.
*43. Clean and lubricate a horizontal mill.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop Lathes. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981. (Objectives 1-24)

Dunn, James. Machine Shop Grinding Machines. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1983. (Objectives 25-36)

Dunn, James. Machine Shop Milling Machines. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1983. (Objectives 37-45)

Evaluation and Suggested Minimum Performance Standards:

Objective 1: The student will describe the use of five different types of lathes.
*Objective 2: The student will identify the four major parts of an engine lathe and 24 subparts of an engine lathe and state the use of each subpart.
*Objective 3: The student will identify 20 different accessories used on lathes and state the use of each.
*Objective 4: The student will state six rules for the care and cleaning of engine lathe.
*Objective 5: The student will state ten rules for the safe use of an engine lathe.
*Objective 6: The student will describe 12 basic operations performed on a lathe.
*Objective 7: The student will identify four different types of tool posts and toolholders and state the use of each.
*Objective 8: The student will identify 20 basic shapes of single-point cutting tools.
Objective 9: The student will state three advantages and two disadvantages of carbide cutting tools and one advantage and three disadvantages of high speed steel cutting tools.

*Objective 10: The student will use shop formulas and charts to complete an assignment sheet to determine lathe speeds and feeds.

*Objective 11: The student will free-hand grind a turning tool to specifications.

*Objective 12: The student will free-hand grind a facing tool to specifications.

*Objective 13: The student will free-hand grind a 60-degree threading tool to specifications.

*Objective 14: The student will sharpen a cutoff tool blade to specifications.

*Objective 15: The student will operate lathe controls following manufacturer's procedures.

*Objective 16: The student will complete an assignment sheet on using taper formulas to calculate dimensions.

Objective 17: The student will identify seven parts of the American National thread form.

*Objective 18: The student will identify six common thread forms.

*Objective 19: The student will four methods for measuring thread pitch diameters.

*Objective 20: The student will remove and install a lathe chuck following manufacturer's specifications and procedures.

*Objective 21: The student will perform a facing operation to specifications.

*Objective 22: The student will face a part to a specified length.

*Objective 23: The student will perform a straight turning operation to specifications.

*Objective 24: The student will turn a part with square shoulder to a specified length.

*Objective 25: The student will perform a center-drilling operation to specifications.

Objective 26: The student will identify four parts of a grinding wheel.

Objective 27: The student will state a use for each of four common types of grinding wheels.

Objective 28: The student will describe three factors used in determining the composition of a grinding wheel.

Objective 29: The student will identify four different types of abrasive cutting machines.

*Objective 30: The student will state three reasons for truing and balancing grinding wheels.

Objective 31: The student will identify 12 parts of a surface grinder and state the function of each part.

Objective 32: The student will list and describe five grinding operations problems and four possible causes of each problem.

*Objective 33: The student will state 12 rules for grinding machine safety.

*Objective 34: The student will operate surface grinder controls following manufacturer's procedures.

*Objective 35: The student will balance a grinding wheel to specifications.

*Objective 36: The student will identify five surface grinding operations.
*Objective 37: The student will state five safety rules that apply to magnetic chuck work.
Objective 38: The student will name five types of milling machines.
Objective 39: The student will identify ten parts of a horizontal knee-and-column mill and state the use of each part.
*Objective 40: The student will identify seven work holding devices, 17 cutting tools, five tool holders, and four other attachments used with milling machines.
*Objective 41: The student will state 16 rules applying to milling machine safety.
*Objective 42: The student will adjust machine speed and feed rates to specifications.
*Objective 43: The student will clean and lubricate a horizontal mill following manufacturer's procedures.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ 1. Described the use of the different types of lathes.
____ *2. Identified the parts and subparts of an engine lathe and state the use of each.
____ *3. Identified and stated the use of common lathe accessories.
____ *4. Stated rules for the care and cleaning of engine lathe.
____ *5. Stated rules for the safe use of an engine lathe.
____ *6. Described the basic operations performed on a lathe.
____ *7. Identified the different types of tool posts and toolholders and stated the use of each.
____ *8. Identified basic shapes of single-point cutting tools.
____ 9. Stated advantages and disadvantages of carbide and high speed steel cutting tools.
____*10. Used shop formulas and charts to determine lathe speeds and feeds.
____*11. Free-hand ground a turning tool.
____*12. Free-hand ground a facing tool.
____*13. Free-hand ground a 60-degree threading tool.
____*14. Sharpened a cutoff tool blade.
____*15. Operated lathe controls.
____*16. Used taper formulas to calculate dimensions.
____*17. Identified parts of the American National thread form.
____*18. Identified thread forms.
____*19. Listed methods for measuring thread pitch diameters.
____*20. Removed and install a lathe chuck.
____*21. Performed a facing operation.
____*22. Faced a part to length.
____*23. Performed a straight turning operation.
____*24. Turned a part with square shoulder to length.
____*25. Performed a center-drilling operation.
____ 26. Identified the parts of a grinding wheel.
____ 27. Stated a use for each of the common grinding wheel types.

____ 28. Described factors used in determining the composition of a grinding wheel.
____ 29. Identified the different types of abrasive cutting machines.
____*30. Stated reasons for truing and balancing grinding wheels.
____ 31. Identified the parts of a surface grinder and stated the function of each part.
____ 32. Listed and described grinding operations problems and their causes.
____*33. Stated rules for grinding machine safety.
____*34. Operated surface grinder controls.
____*35. Balanced a grinding wheel.
____*36. Identified surface grinding operations.
____*37. Stated safety rules that apply to magnetic chuck work.
____ 38. Named the types of milling machines.
____ 39. Identified the parts of a horizontal knee-and-column mill and stated the use of each part.
____*40. Identified work holding devices, cutting tools, tool holders, and other attachments used with milling machines.
____*41. Stated rules applying to milling machine safety.
____*42. Adjusted machine speed and feed rates.
____*43. Cleaned and lubricated a horizontal mill.

*Indicates core/essential objectives

COURSE: Metal Trades I

Unit 8: Basic Sheet Metal Repair

Objectives: Upon completion of this unit, the student will:

*1. Identify common seams, locks, edges, and notches used in sheet metal work.
*2. Identify specialized hand tools used in sheet metal work and state the use of each.
*3. Identify sheet metal working machines and state the use of each.
*4. Identify fasteners used in sheet metal work.
*5. Define basic geometric terms.
*6. Lay out and cut metal rectangles.
*7. Lay out and cut metal circles.
8. Fold, bend, hem, set down, and make drive clips.
9. Lay out, cut, roll, and spot weld cylinders.
10. Form hems and seams on a hand brake.
*11. Lay out, cut, and fasten together a simple box.

*Indcates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Jones, Leonard and Otto Morse. Sheet Metal Basics. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1983.

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will identify six common seams, four locks and clips, four edges, and three notches used in sheet metal work.
*Objective 2: The student will identify 15 specialized hand tools used in sheet metal work and state the use of each.
*Objective 3: The student will identify 12 sheet metal working machines and state the use of each.
*Objective 4: The student will identify ten fasteners used in sheet metal work.
*Objective 5: The student will define six basic geometric terms.
*Objective 6: The student will lay out and cut metal rectangles to specifications.
*Objective 7: The student will lay out and cut metal circles to specifications.
Objective 8: The student will fold, bend, hem, set down, and make drive clips to specifications.

Objective 9: The student will lay out, cut, roll, and spot weld cylinders to specifications.
Objective 10: The student will form hems and seams on a hand brake to specifications.
*Objective 11: The student will lay out, cut, and fasten together a simple box to specifications.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Identified common seams, locks, edges, and notches used in sheet metal work.
____ *2. Identified specialized hand tools used in sheet metal work and stated the use of each.
____ *3. Identified sheet metal working machines and stated the use of each.
____ *4. Identified fasteners used in sheet metal work.
____ *5. Defined basic geometric terms.
____ *6. Laid out and cut metal rectangles.
____ *7. Laid out and cut metal circles.
____ 8. Folded, bent, hemmed, set down, and made drive clips.
____ 9. Laid out, cut, rolled, and spot welded cylinders.
____ 10. Formed hems and seams on a hand brake.
____*11. Laid out, cut, and fastened together a simple box.

*Indicates core/essential objectives

METAL TRADES II

Developed by

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METAL TRADES II

Option A - Advanced Sheet Metal
Unit 1: Advanced Sheet Metal

Option B - Advanced Welding
Unit 1: Advanced Welding

Option C - Advanced Machine Shop Welding
Unit 1: Advanced Machine Shop

(NOTE: Students enrolled in Metal Trades II are expected to select and complete one of the above options.)

COURSE: Metal Trades II (Option A - Advanced Sheet Metal)

Unit 1: Advanced Sheet Metal

Objectives: Upon completion of this unit, the student will:

*1. Identify tools and instruments used in sheet metal pattern layout.
*2. List steps in making a pattern layout drawing.
*3. Identify sheet metal layout tools and state the use of each.
*4. List the steps in transferring a pattern layout to metal.
*5. Perform basic geometric operations.
*6. Lay out and form a rectangular duct.
*7. Lay out and form a square heel and throat elbow.
*8. Lay out and form a square and round heel elbow.
*9. Lay out and form a square to square reducer.
*10. Lay out and form a rectangle to round transition.
*11. Assemble ductwork.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Jones, Leonard and Otto Morse. Basic Sheet Metal Layout and Fabrication. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1983.

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will identify six tools and instruments used in sheet metal pattern layout.
*Objective 2: The student will list five steps in making a pattern layout drawing in their proper order.
*Objective 3: The student will identify four sheet metal layout tools and state the use of each.
*Objective 4: The student will list six steps in transferring a pattern layout to metal in their proper order.
*Objective 5: The student will perform the following basic geometric operations:
a. bisect a line.
b. bisect an angle.
c. erect a perpendicular at the end of a line.
d. construct parallel lines.
e. construct an equilateral triangle.
f. create 30- and 60-degree angles with a compass.
*Objective 6: The student will lay out and form a rectangular duct to specifications.

*Objective 7: The student will lay out and form a square heel and throat elbow to specifications.
*Objective 8: The student will lay out and form a square and round heel elbow to specifications.
*Objective 9: The student will lay out and form a square to square reducer to specifications.
*Objective 10: The student will lay out and form a rectangle to round transition to specifications.
*Objective 11: The student will assemble ductwork to specifications.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Identified tools and instruments used in sheet metal pattern layout.
____ *2. Listed steps in making a pattern layout drawing.
____ *3. Identified sheet metal layout tools and state the use of each.
____ *4. Listed the steps in transferring a pattern layout to metal.
____ *5. Performed basic geometric operations.
____ *6. Laid out and formed a rectangular duct.
____ *7. Laid out and formed a square heel and throat elbow.
____ *8. Laid out and formed a square and round heel elbow.
____ *9. Laid out and formed a square to square reducer.
____*10. Laid out and formed a rectangle to round transition.
____*11. Assembled ductwork.

*Indicates core/essential objectives

COURSE: Metal Trades II (Option B - Advanced Welding)

Unit 1: Advanced Welding

Objectives: Upon completion of this unit, the student will:

*1. Make a flame beveled cut on mild steel plate. (oxyacetylene)
*2. Cut a hole in mild steel. (oxyacetylene)
*3. Weld butt joints with a filler rod. (oxyacetylene)
*4. Construct a lap joint in the overhead position. (SMAW)
5. List advantages and limitations of gas tungsten arc welding (GTAW).
6. List applications of GTAW.
*7. Describe the principles of GTAW.
*8. State rules of safety related to the use of GTAW equipment.
*9. Identify the major controls on a GTAW machine and state the function of each.
*10. Identify the parts of a GTAW torch and state the function of each.
*11. Identify the different types of cups used on a GTAW torch and state the applications of each.
*12. State the color, finish, and application for the different types of tungsten electrodes.
*13. List the characteristics of a good GTAW weld and list the causes of poor welds.
*14. State the characteristics of argon and helium gases used in GTAW welding.
*15. Set up a GTAW welder.
*16. Run stringer beads in the flat position. (GTAW)
*17. Construct a square grove butt weld. (GTAW)
*18. Construct a lap joint fillet weld. (GTAW)
*19. Construct an outside corner fillet weld joint. (GTAW)
*20. Construct a T-joint fillet weld in the horizontal position. (GTAW)
*21. Construct a T-joint fillet weld in the vertical position. (GTAW)
*22. List the advantages and limitations of gas metal arc welding (GMAW).
*23. Describe principles of GMAW.
*24. Describe applications of GMAW.
*25. Identify the machine controls on a GMAW welder and state the function of each.
*26. Describe the short circuit transfer and spray arc metal transfer processes.
*27. State rules of thumb for GMAW electrode selection.
*28. Describe the uses of the common shielding gases in GMAW.
*29. Describe the effects of electrode stick out (ESO) on voltage and amperage.
*30. Set up and shut down GMAW equipment for short circuit transfer.
*31. Construct a T-joint fillet weld in the horizontal position. (GMAW)
*32. Construct a lap joint fillet weld in the vertical position. (GMAW)

*33. Construct a V-groove butt joint weld in the flat position. (GMAW)
*34. Construct a V-groove butt joint weld in the horizontal position. (GMAW)
*35. Construct a T-joint weld in the vertical position. (GMAW)
*36. Construct a V-groove butt joint weld in the vertical position. (GMAW)
*37. Construct a T-joint fillet weld in the overhead position. (GMAW)
*38. Construct a V-groove butt weld in the overhead position. (GMAW)

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Fortney, Clarence and Gregory, Mike. Oxyacetylene Welding and Cutting. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984. (Objectives 1-3)

Fortney, Clarence and Gregory, Mike. SMAW: Shielded Metal Arc Welding. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984. (Objective 4)

Fortney, Clarence and Gregory, Mike. GTAW: Gas Tungsten Arc Welding. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984. (Objectives 5-21)

Fortney, Clarence and Gregory, Mike. GMAW and FCAW: Gas Metal Arc Welding and Flux-Cored Arc Welding. Stillwater, OK: Mid-America Vocational Curriculum Consortium. 1984. (Objectives 22-37)

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: Using an oxyacetylene cutting torch, the student will make a flame beveled cut on mild steel plate to specifications.
*Objective 2: Using an oxyacetylene cutting torch, the student will cut a hole in mild steel to specifications.
*Objective 3: Using an oxyacetylene welding torch, the student will weld butt joints to specifications with a filler rod.
*Objective 4: Using SMAW equipment, the student will construct a lap joint in the overhead position to specifications.
Objective 5: The student will list five advantages and two limitations of gas tungsten arc welding (GTAW).
Objective 6: The student will list three applications of GTAW.

*Objective 7: The student will describe the principles of GTAW in terms of heat generation, shielding gas, and filler rod.

*Objective 8: The student will state 15 rules related to electrical, duty cycle, and the handling of cables and gas and coolant hoses in the use of GTAW equipment.

*Objective 9: The student will identify eight major controls on a GTAW machine and state the function of each.

*Objective 10: The student will identify five basic parts of a GTAW torch and state the function of each.

*Objective 11: The student will identify three different types of cups used on a GTAW torch and state an application of each.

*Objective 12: The student will state the color, finish, and application for three different types of tungsten electrodes.

*Objective 13: The student will list four characteristics of a good GTAW weld and list four possible causes of poor welds.

*Objective 14: The student will state three characteristics of argon and helium gases used in GTAW welding.

*Objective 15: The student will set up a GTAW welder following industry procedures and including the adjustment of the flow meter regulator.

*Objective 16: The student will run stringer beads in the flat position on aluminum plate using GTAW equipment.

*Objective 17: The student will construct to specifications a square grove butt weld in the flat position using GTAW equipment.

*Objective 18: The student will construct to specifications a lap joint fillet weld in the vertical position using GTAW equipment.

*Objective 19: The student will construct to specifications an outside corner fillet weld joint in the vertical position using GTAW equipment.

*Objective 20: The student will construct to specifications a T-joint fillet weld in the horizontal position using GTAW equipment.

*Objective 21: The student will construct to specifications a T-joint fillet weld in the vertical position using GTAW equipment.

*Objective 22: The student will list five advantages and two limitations of gas metal arc welding (GMAW).

*Objective 23: The student will describe principles of GMAW in terms of current and polarity, electrode feed, and shielding gases.

*Objective 24: The student will describe three applications of GMAW.

*Objective 25: The student will identify six basic machine controls on a GMAW welder and state the function of each.

*Objective 26: The student will describe and compare the short circuit transfer and spray arc metal transfer processes.

*Objective 27: The student will state three rules of thumb for GMAW electrode selection.

*Objective 28: The student will describe uses of three common shielding gases in GMAW.

*Objective 29: The student will describe two effects of electrode stick out (ESO) on voltage and amperage.

*Objective 30: The student will set up and shut down GMAW equipment for short circuit transfer.

*Objective 31: The student will construct to specifications a T-joint fillet weld in the horizontal position using GMAW equipment and the short circuit transfer process.

*Objective 32: The student will construct to specifications a lap joint fillet weld in the vertical position using GMAW equipment and the short circuit transfer process.

*Objective 33: The student will construct to specifications a V-groove butt joint weld in the flat position using GMAW equipment and the short circuit transfer process.

*Objective 34: The student will construct to specifications a V-groove butt joint weld in the horizontal position using GMAW equipment and the short circuit transfer process.

*Objective 35: The student will construct to specifications a T-joint weld in the vertical position using GMAW equipment and the short circuit transfer process.

*Objective 36: The student will construct to specifications a V-groove butt joint weld in the vertical position using GMAW equipment and the short circuit transfer process.

*Objective 37: The student will construct to specifications a T-joint fillet weld in the overhead position using GMAW equipment and the short circuit transfer process.

*Objective 38: The student will construct to specifications a V-groove butt weld in the overhead position using GMAW equipment and the short circuit transfer process.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Made a flame beveled cut on mild steel plate. (oxyacetylene)
____ *2. Cut a hole in mild steel. (oxyacetylene)
____ *3. Welded butt joints with a filler rod. (oxyacetylene)
____ *4. Constructed a lap joint in the overhead position. (SMAW)
____ 5. Listed advantages and limitations of gas tungsten arc welding (GTAW).
____ 6. Listed applications of GTAW.
____ *7. Described the principles of GTAW.
____ *8. Stated rules of safety related to the use of GTAW equipment.
____ *9. Identified the major controls on a GTAW machine and stated the function of each.
____*10. Identified the parts of a GTAW torch and stated the function of each.
____*11. Identified the different types of cups used on a GTAW torch and stated the applications of each.
____*12. Stated the color, finish, and application for the different types of tungsten electrodes.
____*13. Listed the characteristics of a good GTAW weld and the causes of poor welds.

____*14. Stated the characteristics of argon and helium gases used in GTAW welding.
____*15. Set up a GTAW welder.
____*16. Ran stringer beads in the flat position. (GTAW)
____*17. Constructed a square grove butt weld. (GTAW)
____*18. Constructed a lap joint fillet weld. (GTAW)
____*19. Constructed an outside corner fillet weld joint. (GTAW)
____*20. Constructed a T-joint fillet weld in the horizontal position. (GTAW)
____*21. Constructed a T-joint fillet weld in the vertical position. (GTAW)
____*22. Listed the advantages and limitations of gas metal arc welding (GMAW).
____*23. Described principles of GMAW.
____*24. Described applications of GMAW.
____*25. Identify the machine controls on a GMAW welder and stated the function of each.
____*26. Described the short circuit transfer and spray arc metal transfer processes.
____*27. Stated rules of thumb for GMAW electrode selection.
____*28. Described the uses of the common shielding gases in GMAW.
____*29. Described the effects of electrode stick out (ESO) on voltage and amperage.
____*30. Set up and shut down GMAW equipment for short circuit transfer.
____*31. Constructed a T-joint fillet weld in the horizontal position. (GMAW)
____*32. Constructed a lap joint fillet weld in the vertical position. (GMAW)
____*33. Constructed a V-groove butt joint weld in the flat position. (GMAW)
____*34. Constructed a V-groove butt joint weld in the horizontal position. (GMAW)
____*35. Constructed a T-joint weld in the vertical position. (GMAW)
____*36. Constructed a V-groove butt joint weld in the vertical position. (GMAW)
____*37. Constructed a T-joint fillet weld in the overhead position. (GMAW)
____*38. Constructed a V-groove butt weld in the overhead position. (GMAW)

*Indicates core/essential objectives

COURSE: Metal Trades II (Option C - Advanced Machine Shop Option)

Unit 1: Advanced Machine Shop

Objectives: Upon completion of this unit, the student will:

*1. Use an engine lathe to perform a chamfer operation.
*2. Use an engine lathe to perform a recessing operation.
*3. Use an engine lathe to perform a knurling operation.
*4. Use an engine lathe to drill and recess a hole.
*5. Use lathe center to align and start a tap.
*6. Use an engine lathe to perform cutoff operations.
*7. Use an engine lathe to turn between centers.
*8. Use an engine lathe to turn a taper with taper attachment.
*9. Use an engine lathe to turn a taper with compound.
*10. Use an engine lathe to perform boring operations.
*11. Use an engine lathe to cut external threads to relief.
*12. Use an engine lathe to pick up threads.
*13. Use an engine lathe to cut internal threads.
*14. Remove and replace a grinding wheel on a grinding machine.
*15. Dress a grinding machine wheel flat.
*16. Grind a workpiece flat and parallel.
*17. Grind a workpiece square.
*18. Grind an angular surface.
*19. Grind a workpiece to dimension.
*20. Dress a grinding wheel to a 90-degree included angle.
*21. Identify the parts of a milling machine indexing or driving head and their function(s).
22. Identify operations performed on an indexing or driving head of a milling machine.
*23. Calculate direct and simple indexing.
*24. Describe the different types of horizontal milling operations.
*25. List horizontal milling operations required to make parts.
*26. Mount arbors and adjust arbor support bushing on a horizontal milling machine.
*27. Use horizontal milling machine controls properly.
*28. Mount a cutter to a horizontal milling machine arbor.
*29. Mount and align a swivel-base vise.
*30. Mill square a workpiece mounted in a vise.
*31. Mill a keyway.
*32. Mill to blueprint specifications using machine controls.
*33. Describe the different types of vertical milling machine operations.
*34. Mount and remove cutters and cutter holders for vertical spindle milling machines.
*35. Use vertical milling machine controls properly.
*36. Mount and align a vise on a vertical milling machine.
*37. Perform selected vertical milling and boring operations.
38. List basic computerized numerical control (CNC) machine controls.
39. Describe the G-codes and N-codes used in CNC operations.
40. Describe basic programming operations using the X, Y, and Z axes for milling machines.

41. Describe basic programming operations using the X and Z axes for lathes.

*Indicates core/essential objectives

Suggested Instructional Practices:

Lecture-discussion
Laboratory demonstration and practice

Suggested Resources:

Primary Resource: Dunn, James. Machine Shop Lathes. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1981. (Objectives 1-13)

Dunn, James. Machine Shop Grinding Machines. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1983. (Objectives 14-20)

Dunn, James. Machine Shop Milling Machines. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education. 1983. (Objectives 21-38)

Evaluation and Suggested Minimum Performance Standards:

*Objective 1: The student will perform a chamfer operation to specifications using an engine lathe.
*Objective 2: The student will perform a recessing operation to specfications using an engine lathe.
*Objective 3: The student will perform a knurling operation to specifications using an engine lathe.
*Objective 4: The student will drill and recess a hole to specifications using an engine lathe.
*Objective 5: The student will align and start a tap to specfications using an engine lathe and lathe center.
*Objective 6: The student will perform cutoff operations to specifications using an engine lathe.
*Objective 7: The student willl turn between centers to specifications using an engine lathe.
*Objective 8: The student will turn a taper to specifications on an engine lathe with taper attachment.
*Objective 9: The student will turn a taper with compound to specifications using an engine lathe.
*Objective 10: The student will perform boring operations to specifications with an engine lathe.
*Objective 11: The student will cut external threads to relief as per specifications on an engine lathe.
*Objective 12: The student will pick up threads to specifications with an engine lathe.
*Objective 13: The student will cut internal threads to specifications with an engine lathe.

*Objective 14: The student will remove and replace a grinding wheel on a grinding machine folllowing manufacturer's procedures.
*Objective 15: The student will dress a grinding machine wheel flat to manufacturer's specifications.
*Objective 16: The student will grind a workpiece flat and parallel as per specifications.
*Objective 17: The student will grind a workpiece square as per sepcifications.
*Objective 18: The student will grind an angular surface as per specifications.
*Objective 19: The student will grind a workpiece to dimension as per specifications.
*Objective 20: The student will dress a grinding wheel to a 90-degree included angle.
*Objective 21: The student will identify seven parts of a milling machine indexing or driving head and state one function of each.
Objective 22: The student will identify six operations performed on an indexing or driving head of a milling machine.
*Objective 23: The student will calculate direct and simple indexing.
*Objective 24: The student will describe six different types of horizontal milling operations.
*Objective 25: The student will complete an assignment sheet that lists horizontal milling operations required to make parts.
*Objective 26: The student will mount arbors and adjust arbor support bushing to manufacturer's specifications on a horizontal milling machine.
*Objective 27: The student will demonstrate the proper use of horizontal milling machine controls including common hand and power operations.
*Objective 28: The student will mount a cutter to a horizontal milling machine arbor as per manufacturer's specifications.
*Objective 29: The student will mount and align a swivel-base vise as per manufaturer's procedures.
*Objective 30: The student will mill square a workpiece mounted in a vise to specifications.
*Objective 31: The student will mill a keyway to specifications.
*Objective 32: The student will mill a part to blueprint specifications using machine controls.
*Objective 33: The student will describe eight different types of vertical milling machine operations.
*Objective 34: The student will mount and remove cutters and cutter holders for vertical spindle milling machines as per manufacturer's specifications.
*Objective 35: The student will use vertical milling machine controls to set spindle speeds and feed controls to specifications.
*Objective 36: The student will mount and align a vise on a vertical milling machine to specifications.
*Objective 37: The student will perform three vertical milling and boring operations as specficied by the instructor.

Objective 38: The student will list basic computerized numerical control (CNC) machine controls.
Objective 39: The student will describe the G-codes and N-codes used in CNC operations.
Objective 40: The student will describe basic programming operations using the X, Y, and Z axes for milling machines.
Objective 41: The student will describe basic programming operations using the X and Z axes for lathes.

*Indicates core/essential objectives

Performance Record: Place a check by each objective the student achieved:

____ *1. Used an engine lathe to perform a chamfer operation.
____ *2. Used an engine lathe to perform a recessing operation.
____ *3. Used an engine lathe to perform a knurling operation.
____ *4. Used an engine lathe to drill and recess a hole.
____ *5. Used lathe center to align and start a tap.
____ *6. Used an engine lathe to perform cutoff operations.
____ *7. Used an engine lathe to turn between centers.
____ *8. Used an engine lathe to turn a taper with taper attachment.
____ *9. Used an engine lathe to turn a taper with compound.
____*10. Used an engine lathe to perform boring operations.
____*11. Used an engine lathe to cut external threads to relief.
____*12. Used an engine lathe to pick up threads.
____*13. Used an engine lathe to cut internal threads.
____*14. Removed and replaced a grinding wheel on a grinding machine.
____*15. Dressed a grinding machine wheel flat.
____*16. Ground a workpiece flat and parallel.
____*17. Ground a workpiece square.
____*18. Ground an angular surface.
____*19. Ground a workpiece to dimension.
____*20. Dressed a grinding wheel to a 90-degree included angle.
____*21. Identified the parts of a milling machine indexing or driving head and their function(s).
____ 22. Identified operations performed on an indexing or driving head of a milling machine.
____*23. Calculated direct and simple indexing.
____*24. Described the different types of horizontal milling operations.
____*25. Listed horizontal milling operations required to make parts.
____*26. Mounted arbors and adjusted arbor support bushing on a horizontal milling machine.
____*27. Used horizontal milling machine controls properly.
____*28. Mounted a cutter to a horizontal milling machine arbor.
____*29. Mounted and aligned a swivel-base vise.
____*30. Milled square a workpiece mounted in a vise.
____*31. Milled a keyway.
____*32. Milled to blueprint specifications using machine controls.
____*33. Described the different types of vertical milling machine operations.

____*34. Mounted and removed cutters and cutter holders for vertical spindle milling machines.
____*35. Used vertical milling machine controls properly.
____*36. Mounted and aligned a vise on a vertical milling machine.
____*37. Performed selected vertical milling and boring operations.
____ 38. Listed basic computerized numerical control (CNC) machine controls.
____ 39. Described the G-codes and N-codes used in CNC operations.
____ 40. Described basic programming operations using the X, Y, and Z axes for milling machines.
____ 41. Described basic programming operations using the X and Z axes for lathes.

*Indicates core/essential objectives

STUDENT PERFORMANCE RECORD

METAL TRADES

METAL TRADES I

Student: _____

This record is provided as an alternative to the student performance records at the end of each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

Place a check by each objective the student achieved; you may also wish to note the date that the student achieved the objective.

C = Core competencies.

____ 1. Defined job titles associated with machine trades.
____ 2. Described personal traits and responsibilities necessary for machine trades workers.
____ C3. Identified the uses of the safety colors.
____ C4. Described factors which contribute to personal safety.
____ C5. Described factors which contribute to general shop safety.
____ C6. Described factors which contribute to the maintenance of clean and orderly shop areas.
____ C7. Evaluated shop situations involving hazards.
____ C8. Calculated problems using fractions.
____ C9. Calculated problems using decimals.
____ C10. Identified the meaning of common blueprint symbols.
____ 11. Wrote the meanings of abbreviations commonly used on blueprints.
____ C12. Identified the alphabet of lines used on blueprints.
____ C13. Identified the types of views shown on blueprints.
____ C14. Defined the terms dimension and tolerance.
____ C15. Identified industry methods for showing dimensions and tolerance.
____ C16. Interpreted information found in the title block of a blueprint.
____ C17. Read an industrial blueprint.
____ C18. Used a steel rule.
____ C19. Used a combination set.
____ 20. Identified the major parts of a micrometer.
____ C21. Selected the proper micrometer for a given application.
____ C22. Read a micrometer setting.
____ C23. Used an outside vernier micrometer.
____ C24. Used a depth micrometer.
____ 25. Described the use of the different types of dial indicators.
____ C26. Aligned a vise using a dial indicator.
____ C27. Aligned a 4-jaw chuck with a dial indicator.
____ 28. Identified gaging and inspection tools.
____ 29. Identified correct uses of gaging and inspection tools.
____ C30. Used gage blocks.
____ C31. Distinguished between ferrous, non-ferrous, and non-metallic materials.
____ 32. Performed a file and spark test.
____ C33. Identified common hand tools and state the use of each.

____ C34. Stated rules for the safe use and care of hand tools.
____ 35. Listed reasons for tap failure.
____ C36. Determined the proper size tap drill.
____ C37. Performed layout with a combination square, and sawed and filed to layout.
____ C38. Stated safety rules that apply to the pedestal grinder.
____ 39. Interpreted the numbering system for grinding wheels.
____ 40. Discussed factors to consider in the care and storage of grinding wheels.
____ C41. Inspected and maintained a pedestal grinder.
____ C42. Ground a high speed tool bit.
____ 43. Ground a drill bit.
____ 44. Identified the types of power saws.
____ 45. Listed methods for determining band saw speeds for different materials.
____ 46. Stated factors that determine saw blade selection.
____ C47. Listed rules for safe use of band saws.
____ 48. Described factors to consider in the care and cleaning of power saws.
____ 49. Cut and welded a band saw blade.
____ 50. Coiled and uncoiled a band saw blade.
____ C51. Cut stock to layout with a horizontal band saw.
____ C52. Cut stock to layout with a vertical band saw.
____ 53. Identified the major parts of a drill press.
____ 54. Described operations performed by a drill press.
____ C55. Identified cutting tools used for drill press operations.
____ C56. Identified workholding and setup devices and other accessories used in drill press operations.
____ C57. Stated rules for the safe use of a drill press.
____ 58. Listed and described factors to consider in the care and cleaning of a drill press.
____ C59. Drilled and reamed holes to layout.
____ C60. Countersunk and counterbored holes.
____ C61. Tapped holes using a drill press.
____ C62. Identified the basic equipment used in oxyacetylene welding.
____ C63. Listed safety rules for using oxyacetylene equipment.
____ C64. Identified the parts of a welding torch body and the function of each.
____ C65. Stated guidelines for flame adjustment.
____ C66. Defined the terms "backfire" and "flashback" and stated possible causes.
____ C67. Identified the basic welding positions.
____ C68. Identified the basic welding joints.
____ C69. Stated elements of good fusion welding.
____ C70. Stated rules of thumb for rod and torch angles.
____ C71. Identified the types of oxyacetylene flames.
____ C72. Stated guidelines for welding tip selection.
____ C73. Listed guidelines for filler rod selection, handling, and safety.
____ C74. Set up equipment for oxyacetylene welding.
____ C75. Laid beads on a flat plate with no filler rod.
____ C76. Welded an outside corner joint in the flat position

____ C77. Identified the parts of an oxyacetylene cutting torch.
____ C78. Set up equipment for oxyacetylene cutting.
____ C79. Made 90-degree cuts on mild steel.
____ C80. Distinguished between fusion welding and brazing.
____ 81. Listed advantages and limitations of braze welding.
____ C82. Stated the purposes of flux.
____ 83. Listed factors in successful braze welding.
____ 84. Described the technique for braze welding steel and cast iron.
____ C85. Braze welded a square groove butt joint in the flat position.
____ 86. Described the relationship between the elements of shielded metal arc welding (SMAW).
____ C87. Described how flux-covered electrodes work.
____ C88. Stated safety rules related to SMAW welding.
____ C89. Listed safety equipment required for SMAW welding.
____ 90. Described the basic electrical characteristics of welding machines.
____ 91. Described the performance characteristics of the different types of SMAW welding machines.
____ C92. Identified the meaning of the numbers in the AWS electrode code classification.
____ 93. Described the basic elements of arc welding.
____ C94. Identified electrode angles.
____ C95. Described SMAW welding techniques.
____ C96. Identified bead running techniques and state the applications of each.
____ C97. Described the procedures for restarting an arc and for filling a crater.
____ C98. Described the characteristics of good and bad welds.
____ C99. Listed factors which contribute to poor welds and stated the cause and solution of each.
____C100. Struck and restruck an arc, and cratered and backfilled a bead.
____C101. Built a pad.
____C102. Constructed a V-groove butt joint in the flat position.
____C103. Constructed a V-groove butt joint in the horizontal position.
____C104. Constructed a multiple pass T-joint in the horizontal position.
____C105. Constructed a T-joint in the vertical up position.
____C106. Constructed a V-groove butt joint in the vertical down position.
____ 107. Described the use of the different types of lathes.
____C108. Identified the parts and subparts of an engine lathe and state the use of each.
____C109. Identified and stated the use of common lathe accessories.
____C110. Stated rules for the care and cleaning of engine lathe.
____C111. Stated rules for the safe use of an engine lathe.
____C112. Described the basic operations performed on a lathe.
____C113. Identified the different types of tool posts and toolholders and stated the use of each.

____C114. Identified basic shapes of single-point cutting tools.
____ 115. Stated advantages and disadvantages of carbide and high speed steel cutting tools.
____C116. Used shop formulas and charts to determine lathe speeds and feeds.
____C117. Free-hand ground a turning tool.
____C118. Free-hand ground a facing tool.
____C119. Free-hand ground a 60-degree threading tool.
____C120. Sharpened a cutoff tool blade.
____C121. Operated lathe controls.
____C122. Used taper formulas to calculate dimensions.
____C123. Identified parts of the American National thread form.
____C124. Identified thread forms.
____C125. Listed methods for measuring thread pitch diameters.
____C126. Removed and install a lathe chuck.
____C127. Performed a facing operation.
____C128. Faced a part to length.
____C129. Performed a straight turning operation.
____C130. Turned a part with square shoulder to length.
____C131. Performed a center-drilling operation.
____ 132. Identified the parts of a grinding wheel.
____ 133. Stated a use for each of the common grinding wheel types.
____ 134. Described factors used in determining the composition of a grinding wheel.
____ 135. Identified the different types of abrasive cutting machines.
____C136. Stated reasons for truing and balancing grinding wheels.
____ 137. Identified the parts of a surface grinder and stated the function of each part.
____ 138. Listed and described grinding operations problems and their causes.
____C139. Stated rules for grinding machine safety.
____C140. Operated surface grinder controls.
____C141. Balanced a grinding wheel.
____C142. Identified surface grinding operations.
____C143. Stated safety rules that apply to magnetic chuck work.
____ 144. Named the types of milling machines.
____ 145. Identified the parts of a horizontal knee-and-column mill and stated the use of each part.
____C146. Identified work holding devices, cutting tools, tool holders, and other attachments used with milling machines.
____C147. Stated rules applying to milling machine safety.
____C148. Adjusted machine speed and feed rates.
____C149. Cleaned and lubricated a horizontal mill.
____C150. Identified common seams, locks, edges, and notches used in sheet metal work.
____C151. Identified specialized hand tools used in sheet metal work and stated the use of each.
____C152. Identified sheet metal working machines and stated the use of each.
____C153. Identified fasteners used in sheet metal work.
____C154. Defined basic geometric terms.
____C155. Laid out and cut metal rectangles.

____C156. Laid out and cut metal circles.
____ 157. Folded, bent, hemmed, set down, and made drive clips.
____ 158. Laid out, cut, rolled, and spot welded cylinders.
____ 159. Formed hems and seams on a hand brake.
____C160. Laid out, cut, and fastened together a simple box.

METAL TRADES II

Student: _____

This record is provided as an alternative to the student performance records at the end of each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

Place a check by each objective the student achieved; you may also wish to note the date that the student achieved the objective.

C = Core competencies.

____ C1. Identified tools and instruments used in sheet metal pattern layout.
____ C2. Listed steps in making a pattern layout drawing.
____ C3. Identified sheet metal layout tools and state the use of each.
____ C4. Listed the steps in transferring a pattern layout to metal.
____ C5. Performed basic geometric operations.
____ C6. Laid out and formed a rectangular duct.
____ C7. Laid out and formed a square heel and throat elbow.
____ C8. Laid out and formed a square and round heel elbow.
____ C9. Laid out and formed a square to square reducer.
____ C10. Laid out and formed a rectangle to round transition.
____ C11. Assembled ductwork.
____ C12. Made a flame beveled cut on mild steel plate. (oxyacetylene)
____ C13. Cut a hole in mild steel. (oxyacetylene)
____ C14. Welded butt joints with a filler rod. (oxyacetylene)
____ C15. Constructed a lap joint in the overhead position. (SMAW)
____ 16. Listed advantages and limitations of gas tungsten arc welding (GTAW).
____ 17. Listed applications of GTAW.
____ C18. Described the principles of GTAW.
____ C19. Stated rules of safety related to the use of GTAW equipment.
____ C20. Identified the major controls on a GTAW machine and stated the function of each.
____ C21. Identified the parts of a GTAW torch and stated the function of each.
____ C22. Identified the different types of cups used on a GTAW torch and stated the applications of each.
____ C23. Stated the color, finish, and application for the different types of tungsten electrodes.
____ C24. Listed the characteristics of a good GTAW weld and the causes of poor welds.
____ C25. Stated the characteristics of argon and helium gases used in GTAW welding.
____ C26. Set up a GTAW welder.
____ C27. Ran stringer beads in the flat position. (GTAW)
____ C28. Constructed a square grove butt weld. (GTAW)
____ C29. Constructed a lap joint fillet weld. (GTAW)
____ C30. Constructed an outside corner fillet weld joint. (GTAW)

____ C31. Constructed a T-joint fillet weld in the horizontal position. (GTAW)
____ C32. Constructed a T-joint fillet weld in the vertical position. (GTAW)
____ C33. Listed the advantages and limitations of gas metal arc welding (GMAW).
____ C34. Described principles of GMAW.
____ C35. Described applications of GMAW.
____ C36. Identify the machine controls on a GMAW welder and stated the function of each.
____ C37. Described the short circuit transfer and spray arc metal transfer processes.
____ C38. Stated rules of thumb for GMAW electrode selection.
____ C39. Described the uses of the common shielding gases in GMAW.
____ C40. Described the effects of electrode stick out (ESO) on voltage and amperage.
____ C41. Set up and shut down GMAW equipment for short circuit transfer.
____ C42. Constructed a T-joint fillet weld in the horizontal position. (GMAW)
____ C43. Constructed a lap joint fillet weld in the vertical position. (GMAW)
____ C44. Constructed a V-groove butt joint weld in the flat position. (GMAW)
____ C45. Constructed a V-groove butt joint weld in the horizontal position. (GMAW)
____ C46. Constructed a T-joint weld in the vertical position. (GMAW)
____ C47. Constructed a V-groove butt joint weld in the vertical position. (GMAW)
____ C48. Constructed a T-joint fillet weld in the overhead position. (GMAW)
____ C49. Constructed a V-groove butt weld in the overhead position. (GMAW)
____ C50. Used an engine lathe to perform a chamfer operation.
____ C51. Used an engine lathe to perform a recessing operation.
____ C52. Used an engine lathe to perform a knurling operation.
____ C53. Used an engine lathe to drill and recess a hole.
____ C54. Used lathe center to align and start a tap.
____ C55. Used an engine lathe to perform cutoff operations.
____ C56. Used an engine lathe to turn between centers.
____ C57. Used an engine lathe to turn a taper with taper attachment.
____ C58. Used an engine lathe to turn a taper with compound.
____ C59. Used an engine lathe to perform boring operations.
____ C60. Used an engine lathe to cut external threads to relief.
____ C61. Used an engine lathe to pick up threads.
____ C62. Used an engine lathe to cut internal threads.
____ C63. Removed and replaced a grinding wheel on a grinding machine.
____ C64. Dressed a grinding machine wheel flat.
____ C65. Ground a workpiece flat and parallel.
____ C66. Ground a workpiece square.
____ C67. Ground an angular surface.
____ C68. Ground a workpiece to dimension.

____ C69. Dressed a grinding wheel to a 90-degree included angle.
____ C70. Identified the parts of a milling machine indexing or driving head and their function(s).
____ 71. Identified operations performed on an indexing or driving head of a milling machine.
____ C72. Calculated direct and simple indexing.
____ C73. Described the different types of horizontal milling operations.
____ C74. Listed horizontal milling operations required to make parts.
____ C75. Mounted arbors and adjusted arbor support bushing on a horizontal milling machine.
____ C76. Used horizontal milling machine controls properly.
____ C77. Mounted a cutter to a horizontal milling machine arbor.
____ C78. Mounted and aligned a swivel-base vise.
____ C79. Milled square a workpiece mounted in a vise.
____ C80. Milled a keyway.
____ C81. Milled to blueprint specifications using machine controls.
____ C82. Described the different types of vertical milling machine operations.
____ C83. Mounted and removed cutters and cutter holders for vertical spindle milling machines.
____ C84. Used vertical milling machine controls properly.
____ C85. Mounted and aligned a vise on a vertical milling machine.
____ C86. Performed selected vertical milling and boring operations.
____ 87. Listed basic computerized numerical control (CNC) machine controls.
____ 88. Described the G-codes and N-codes used in CNC operations.
____ 89. Described basic programming operations using the X, Y, and Z axes for milling machines.
____ 90. Described basic programming operations using the X and Z axes for lathes.